

## White Paper

# Creating a Video Matrix over IP

As the worlds of AV and IT converge, software is rapidly becoming the new frontier of AV development. In the old days, once there was a picture on the screen and sound coming from the speakers, the “AV Guy” was done. Meanwhile, IT management is a constant process of monitoring and optimizing the flow of data to ensure that information is flowing as quickly and securely as possible to wherever it needs to be.

In this new environment, the old “set-it-and-forget-it” attitude no longer satisfies IT managers who demand constant vigilance and immediate access to AV signal management.

The rapid rise of Video-over-IP signal transmission has given IT Management far more concern about the need to effectively manage AV distribution within their network.

Video over IP products make it easy to extend, split, and switch HD Video over a new or existing Local Area Network. Now you don’t need dedicated Category cabling or fiber to create an extended HD distribution system. You can actually share existing network architecture between your AV and IT devices, with little or no impact on data or video traffic. Your existing router and low-cost Gigabit Ethernet switches, and Category 5e or better cabling can easily handle most applications.

Whether you only need to get a video signal from one part of your network to another, send a video source to multiple displays in different locations, or create a matrix of sources and displays, Video-over-IP products have you covered.

Unlike other products that require an expensive data switch and extensive IT experience to configure and maintain the system, Gefen’s Video over IP solution manages signal routing in the devices themselves, rather than by configuring the router and switches. This lightens the workload on the IT Department, improves network security, and allows configuration without IT administrative access.

Video is delivered with full 1080p60 Full HD quality and less than three frames of latency, while network performance is unimpaired.

While most traditional video matrixes are “square”, having a fixed matrix size like 8 x 8, 16 x 16, or 32 x 32, Gefen’s Video Over IP solutions let you build any size matrix you need- up to 256 sources and over 65,000 displays. This saves a lot of money and offers tremendous flexibility over traditional solutions. For example, a system with four sources and 20 displays only requires 4 Senders and 20 Receivers, while a traditional solution would require a 32 x 32 matrix, with most of its capacity unused.

Another significant advantage is scalability- with an IP matrix, more senders and receivers can be easily added at any time, without replacing any existing hardware, cabling, or configuration.

In addition to HD Video, Gefen’s KVM over IP products deliver USB, RS-232, IR, and analog or digital audio, making them ideal for controlling multiple computers remotely, such as in edit bays, server rooms, or classrooms.

For systems that don’t require USB or analog audio, Gefen’s [EXT-HD2IRS-LAN](#) is a compact and cost-effective solution.



You can mix and match all of Gefen's Video over IP devices as needed. HDMI, DVI, and VGA video can be mixed, matched and converted (within HDCP limitations) without the need for additional equipment.

Control is easy. Gefen Video over IP products feature a built-in web-based control interface and direct keyboard switching using Gefen's [KVM and Video Over IP Keyboard Controller](#) available on the Gefen Web site. The new [EXT-CU-LAN Matrix Controller](#) facilitates enhanced security, control and management options to a Video over IP distribution system, including two independent access levels, traditional push-button control, a full-featured web server interface, and operation via TCP/UDP from any control system that offers IP control.

## **System Design Considerations:**

When designing a video-over IP network, the key issues are Bandwidth and Architecture. Just like managing traffic of any kind, the solution is to avoid congestion by managing the flow.

High-definition video creates a lot of traffic, but if it is carefully routed, it will not interfere with other traffic, such as data, VoIP, and Internet access.

From an IT perspective, the key is to sketch out the network and map signal flows. A Gigabit Ethernet network is suggested at a minimum. A 1080p 60 Hz IP video stream consumes about 150 Mbps. Most network switches, when properly configured, can limit data flow to the ports that are actually being used by video traffic, so the main concerns are where data paths converge, such as links between switches. These links should be capable of carrying the maximum amount of video traffic that is anticipated, and can use 10 GB SFP modules for higher bandwidth along shared pathways.

From the AV side, the key is to limit broadcast data that can clog the network, and use point-to-point or multicast streams that only go where they are needed. The network should be segregated between video and other data and control signals, with redundant pathways between switches where needed.

Keep in mind that only Video Senders generate data traffic. An almost unlimited number of Receivers can therefore be supported.

## **Network Requirements:**

- A Managed Gigabit Ethernet network is required. This means that all signals between devices must travel through Gigabit Ethernet data switches. This does not prevent equipment operating at lower data rates from also operating on the same network. In those cases, video traffic should be blocked from 10/100BaseT ports through switch configuration.
- The Gigabit Ethernet switches must support "Jumbo Frames" and "IGMP (Internet Group Management Protocol) Snooping". IGMP allows the video streams (groups) to be dynamically routed only to those ports requesting it. The IGMP feature prevents the multi-cast video traffic from flooding the network, and can significantly reduce traffic in a layer-3 network. This capability can be determined from the Data Sheet for the particular switch. Any layer-3 switch with IGMP-query capability or layer-2 switch with VLAN capability can be used for routing networked Audio and Video streams. There are many cost effective Gigabit Ethernet switches that meet these requirements.

- The Gefen Video-over-IP devices can be installed on an existing network that meets these requirements, or on a completely separate network. A dedicated video network will make installation and configuration simpler, and is recommended whenever possible. If data or voice are converged on the same network as video, careful consideration must be given to bandwidth management, or video frame-rate will be unacceptable. The Gefen EXT-CU-LAN controller has two Ethernet ports, so it can be connected to both a dedicated video LAN and an existing data network.
- All Network devices must have unique IP Addresses. Since all Gefen Video-over-IP devices are shipped with the same IP Address, it is best to install one device at a time, and change its IP address before installing the next device. However, the special version of the Gefen Syner-G™ Discovery Tool that is built into the EXT-CU-LAN allows multiple devices to be physically installed at once, then re-configured through the Auto-Assign function.
- Any control software or device must have an IP address in the same subnet as all Networked AV devices.
- The maximum direct connection distance between devices is 100 meters (330 feet) over CAT-5e or CAT-6 cable. This distance can be extended in 100 meter (330 feet) increments by using a Gigabit switch as a repeater between devices. Fiber-based network segments can extend the maximum distance between devices up to 10 km.
- Control signals are provided via UDP and can be routed. Video signals are multicast, and can be routed in certain cases. Many Cisco routers require that the routing table be pre-loaded so that the processor doesn't have to touch each packet to determine its destination.

Successful Video-over-IP implementation requires involvement of the facility IT administrator as early as possible in the design process.

### **Recommended Network Switches:**

The Gefen Video-over-IP product line is compatible with a wide variety of data switches that meet the above requirements. While many switches that meet basic requirements will work, the following models have been tested by Gefen for reliable and consistent operation:

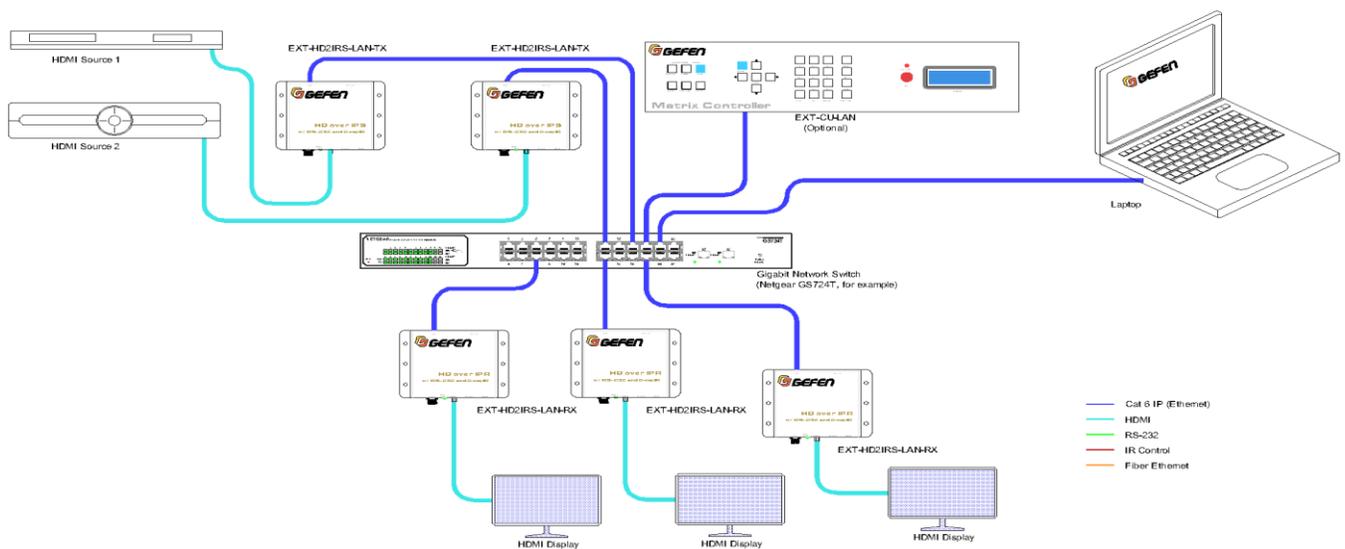
**Netgear GS724T:** For simple installations, the Netgear GS724T is a low-cost 24-port Gigabit Smart Switch that meets all of the requirements. It has two Gigabit SFP ports that can be equipped with fiber SFP modules for greater distances. SFP ports can be equipped with a variety of fiber and copper interface modules to allow a choice of media types, depending on the installation requirements.



**Netgear PROSAFE GS728TXS:** For cascaded or extended switch architecture, more than 1 Gigabit bandwidth may be required between switches. For these situations, the Netgear PROSAFE GS728TXS Gigabit Stackable Smart Switch offers four 10-Gigabit SFP uplink ports for



expanded bandwidth between switches.



**Cisco Small Business SG300 or SG500X:** "X" indicates it has 10G SFP uplink ports.



**Juniper EX-2200 Series:** These switches have been tested and may also be used.



Other brands and models meeting the minimum requirements discussed above may be used, but it will be up to the user to optimize the configuration.

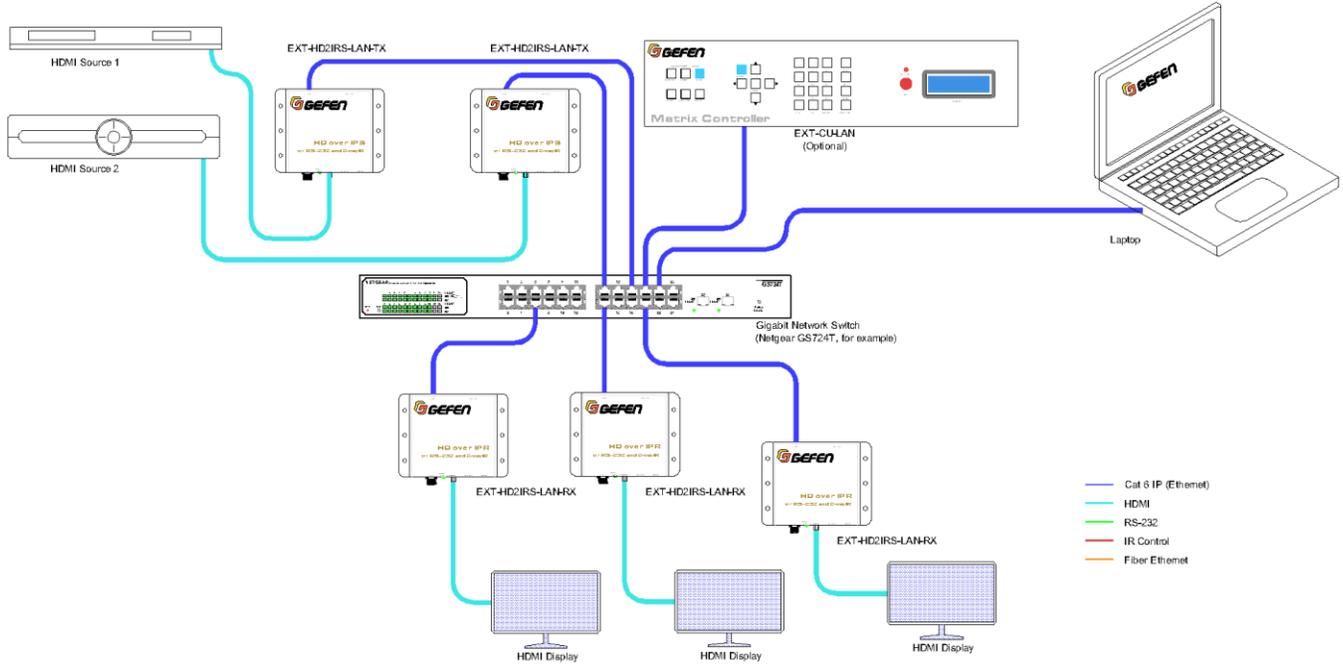


### **Typical System Layouts:**

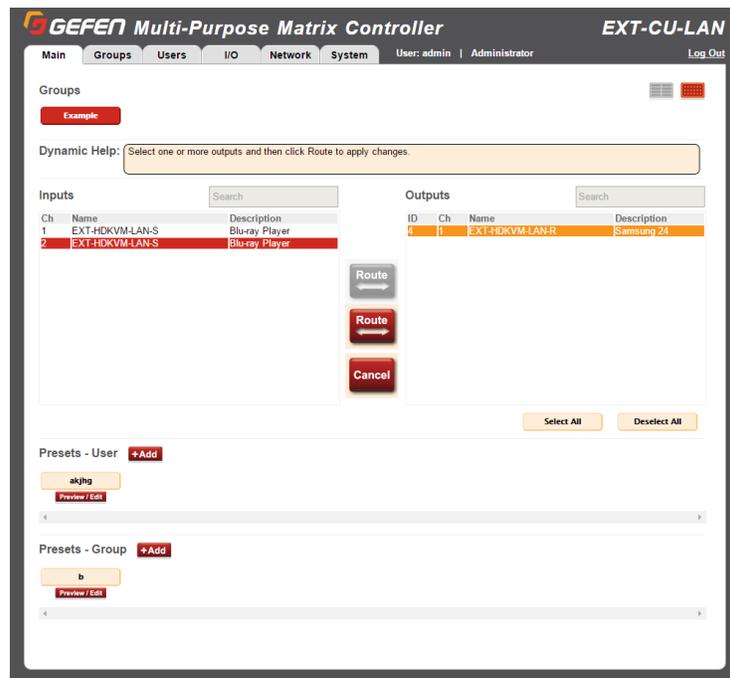
The Gefen EXT-CU-LAN tremendously enhances configuration abilities and control features of a Video over IP installation. However, for simple applications, or where matrix management will be performed by a high-level IP controller, the matrix may be installed without a Gefen EXT-CU-LAN. The network architecture will be the same, but all routing commands will be sent by the external controller, which must also parse return feedback to monitor matrix status. The actual command strings can be found in the User Manuals for the Gefen Video-over-IP devices. The Gefen Syner-G™ software is highly recommended for discovery and manual IP Address assignment of all of the Gefen devices.

For a simple system design (and for testing components prior to installation), all of the devices can be plugged into a single network switch. A router may be added, but is not required. Use Gefen's free Syner-G™ software tool to Discover and connect to the EXT-CU-LAN. Then open the EXT-CU-LAN Web GUI and use Auto-Assign to discover and assign IP addresses to all other Gefen devices on the network.

# Creating a Video Matrix over IP



**Simple System Example**



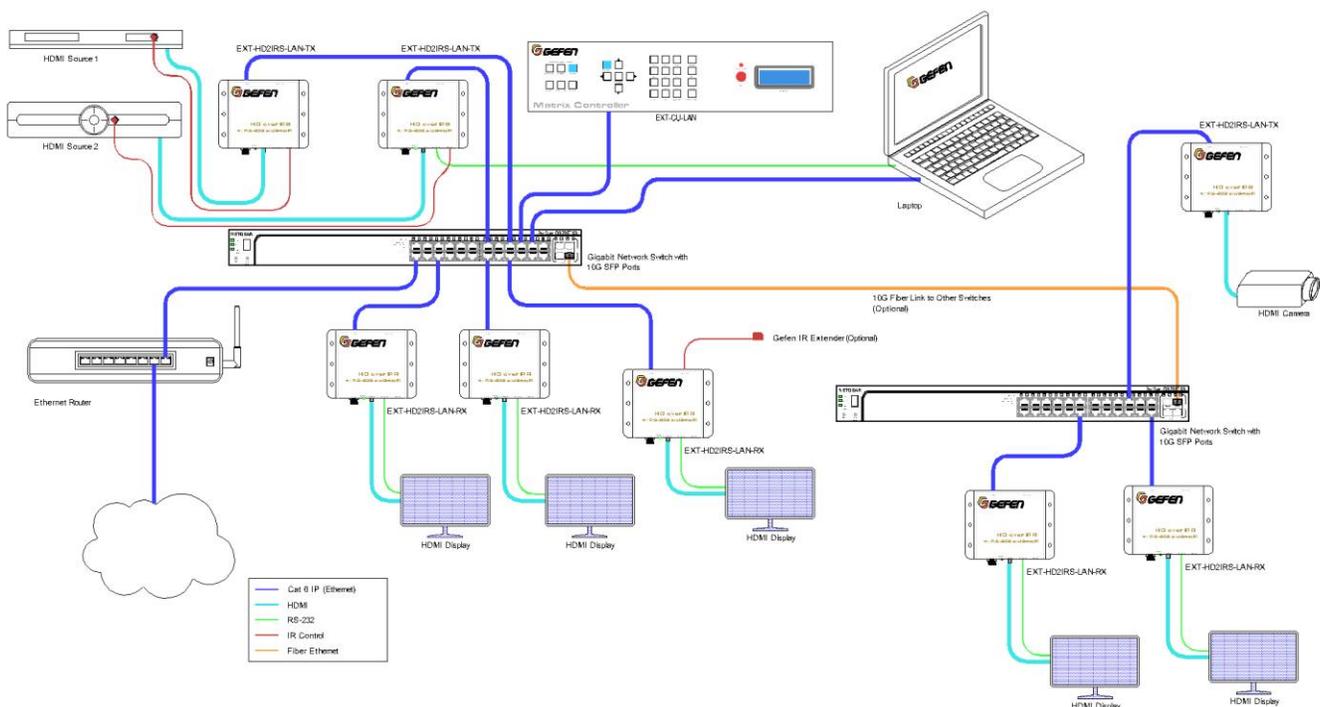
**EXT-CU-LAN Web GUI Routing Screen**

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In a more complex system, or where an extended distance is required between some devices in the matrix, additional switches may be cascaded. In most cases, if more than a single video path may be needed between the switches, a 10GB connection between the switches is required. Using fiber SFP modules, long distances are possible, or a 10GB copper link may be used if the switches are close together.

*Careful analysis of the network architecture will allow you to determine if the system will operate at full capacity without network congestion. In the example below, with two sources on one switch and one on the other, there would be a maximum of three simultaneous streams through the fiber link. Adding more sources on the first switch would not increase the number of streams, since there are only two receivers connected to the second.*



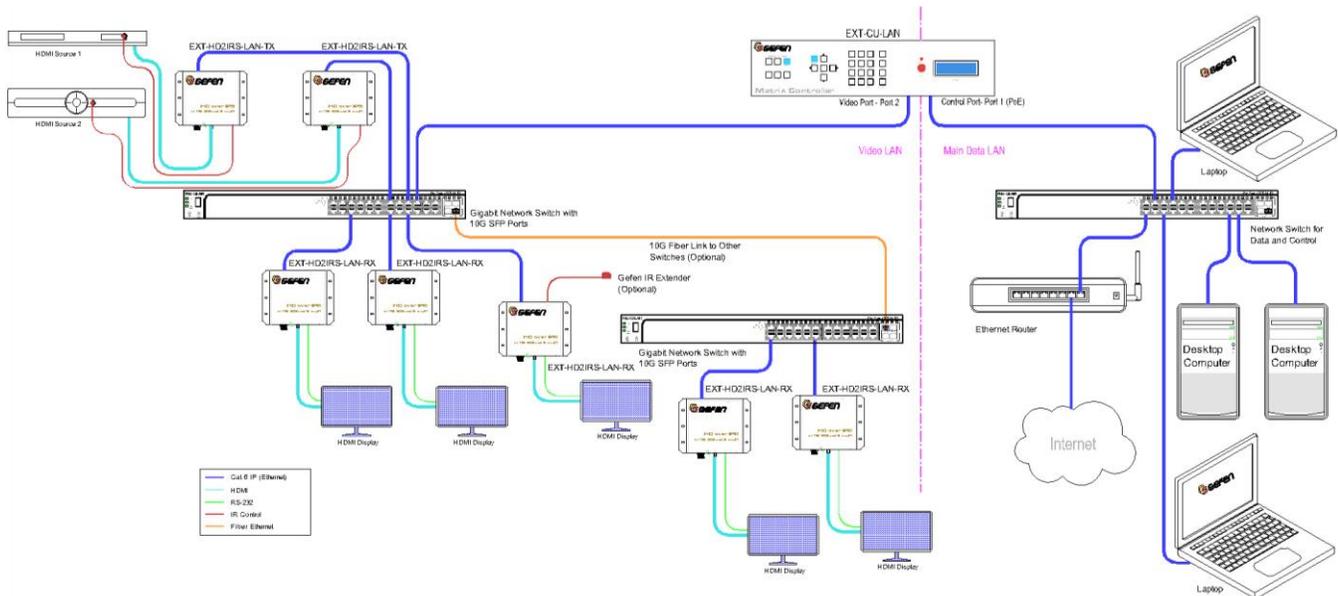
**Cascaded System Example**

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In many cases, it is suggested that the video traffic be segregated from the rest of the data network, to completely eliminate congestion from other data, VoIP services, Internet access, etc. The EXT-CU-LAN has two isolated Ethernet LAN ports to easily enable separation of the video and control networks. This may also be done for security purposes:

*Although the LANs can be completely separate, The EXT-CU-LAN will allow control of Gefen Video-over-IP devices on the Data Network, or control of video devices from computers on the Video Network. Network topology and security are up to the Network Administrator.*



**Split System Example**

## **Hints:**

1. Any or all of the following steps can be taken (at the discretion of your Network Administrator) to facilitate integration with an existing network:
  - Remove Flow Control on any network port passing the video stream.
  - Enable VLANs to separate video traffic from data and voice.
  - Turn Senders off when not in use
2. If encountering performance issues, be sure to check the following:
  - Enable IGMP query and snooping on all supported network switches.
  - Enable Jumbo Frames to 8K or higher
  - Allow multi-cast traffic on all network ports through which video streams pass.
  - The CU-LAN units must have static or locked DHCP addresses. Senders and receivers may use DHCP, although static IP addresses are strongly recommended.

For assistance with other configurations, contact Gefen's Technical Support Team at (800) 545-6900 or [support@gefen.com](mailto:support@gefen.com).

## **Network Addressing:**

One of the most difficult and confusing aspects of IP-Enabled devices is the need to configure IP Addresses and settings to avoid data collision and ensure proper access. Dynamic Host Configuration Protocol (DHCP) offers some assistance, as it allows the system router to automatically assign discrete addresses to each device as they are connected to the network. However, DHCP can create more problems than it solves where devices are constantly added and removed from the network, as addresses can be reassigned unexpectedly, and a device may not always be at the address where other devices expect to find it. Furthermore, DHCP Address assignments may be random, making management difficult. Also, devices in a different Subnet may be masked and invisible, even if they are on the same physical network. Finally, if two or more devices share the same IP Address, neither one will be able to communicate over the network.

**Gefen Syner-G™ Discovery Tool**, also integrated into the EXT-CU-LAN, offers a great solution to common IP configuration problems. Each Gefen Syner-G™-compatible device contains a Discovery "beacon" that allows the Discovery Tool to find and connect to the device, even if it is set to an incompatible Address, and even if it shares an Address with other devices, which would normally block it from communicating at all.

In the past, it was necessary for an AV installer to add one device to a network at a time, reconfigure their PC to match the new device, change the device to fit the network settings, reset the PC back to its original configuration, add the next device, and repeat until all the new devices were properly configured. Now, all new devices can be added at the same time, and the EXT-CU-LAN will allow each device to be quickly and automatically configured to the proper new Address and settings. This is a tremendous timesaver, especially when configuring a large number of Video-over-IP devices into a video matrix.

## **Conclusion:**

As networked AV devices come of age, having effective software tools make the job far easier for the AV professional, as well as making IT Managers more comfortable sharing their network with AV.

An IP Local Area Network (LAN), whether existing or dedicated, is an efficient and viable means of transporting and distributing high-definition video signals. In many cases, creating a video matrix over the LAN is a more cost-effective and a simpler way to route video than the traditional methods of routing all signals to and from a central switching core over dedicated video cabling.

